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IN RELATION TO

SURGICAL PRACTICE.

BY

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SURGICAL PRACTICE.

Gentlemen,—In the month of October of the year 1868 I wrote a note to Mr. Spencer Wells conveying to him an opinion that the time was unfavourable for the performance of the formidable operation with which his name is so familiarly connected, ovariotomy—that the external atmospherical conditions were not only opposed to recovery from operation, but were even conducive to death.

The prediction thus ventured upon—and, indeed, the venture was not very great in presence of the evidence in hand—was verified by the results of practice, and, Mr. Wells having, with a candour which is rarely met, publicly affirmed the fact, it has happened that since the time named I have been repeatedly addressed by various members of the Profession in respect to two questions. Several times it has been asked whether, at a given period then present, there was any serious objection against operation; more frequently a plan of observation or series of rules has been applied for, by which the Surgeon may know for himself what are and what are not favourable seasons for operative proceedings.

It is my intention in the present lecture to try, as far as is possible, to meet the last of these requests, and as it would be

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hard to approach a subject of greater importance, so it is necessary to approach it with equal caution, modesty, and decision; for if the views to be advanced are in the main correct, they will not only give the Surgeon, in very simple rules, an account of the best seasons for operating, but will offer the means of largely reducing the fatality of some operations, the means themselves being simple, inexpensive, natural, true. If I have appeared to have been reticent on this subject too long, the reticence has been due to sense of responsibility in putting forward the details of a reform so large as that which is now in my mind. I have feared lest the charges of enthusiasm and innovation might be levelled with success even against a correct demonstration, (since these charges cost their authors no labour, but form rather an idle pastime), and I have waited therefore to relearn and to feel reassured. I wait now no longer, but proceed sustained by no feeling so powerfully as that those to whom this lecture is addressed are sure to appreciate justly what is to be adduced, and to accept favourably even an approximation to the truth, on a subject so vast as that before us at this moment.

And, in the first place, let me say that the study we are entering upon has a general bearing on disease and its prevalence. The simplest, the most natural of all subjects for study, it has been ignored for the most abstruse and unnatural studies. We observe great outbreaks of disease, and we look for their primary cause: says one, it is "epidemic influence;" says another, it is "germs, organic germs;" says a third, it is "malarious air," and so on, each having a theory and adding to it some learned reason, or so-called practical inference or moral, and all omitting to inquire what may be the action, in regard to causation, of common changes of atmosphere combined or uncombined with natural physiological changes in the living organism. The study we are now upon touches on the omission I have thus noticed. It brings us face to face with simple natural agencies in relation to their effects on our animal motion, and thus it really brings us face to face with the first causes of disease, all of which are simple natural agencies.

My present thesis is to this effect, that there are certain particular conditions, simple atmospheric conditions, which are favourable to the success of Surgical operation: others which are unfavourable: and that these conditions, favourable and unfavourable, admit of being recognised by the means we have now at command in science.

Certain classes of Surgical operation come definitely, I think, under this rule; others are excluded from it. We may exclude minor operations, such as extraction of teeth, all subcutaneous operations, and, in fine, every operation which in an overwhelming majority of cases is unattended with risk to life. Again, we may exclude those larger and dangerous operations which are demanded by accident, and which, at all risks, must be performed in the attempt to ward off threatening death. We may *in*clude, on the other hand, all Surgical operations in which the resistance, excited by the operation, to the continuance of animal motion is hazardous, and in which, at the same time, there is no such immediate demand for the performance of the operation as shall force the Surgeon to procced when the conditions surrounding the patient are opposed to success. These operations constitute the larger part of capital Surgical practice, and the reduction of fatality from them would effect virtually the whole success of Surgery in a nation where every Surgeon practised with a determination to act only under conditions favourable to success, except in emergency.

In seeking out the conditions favourable and unfavourable to Surgical practice, we are bound first to look upon the nature of death after operation. As a rule, an operation may be considered succcssful, in so far as it is itself concerned, if the patient recover from the direct effects of it within ten days after the operation. Indeed, with respect to some of the most extreme operations, such as ovariotomy, the absolute danger of death from the operation may be considered practically as over at the end of one hundred and forty hours. There may be exceptions to this rule, but they need not disturb us. Neither need we be disturbed by the secondary results of operation, such as recurrence of cancer or other growth. We need only consider what it is which kills as the direct result of Surgical interference.

When, then, we narrow our practice to this limit, we find after operation a few prominent and immediate causes of death. They are (*a*) immediate shock, (*b*) syncope from hæmorrhage, (*c*) tetanus, (*d*) gangrene, (*e*) exhaustion from discharge, (*f*) increment of animal heat from resistance, giving rise to one or other of the types, apparently different, but really the same in essence, of Surgical fever. The last of these causes of death is that which fills up the balance-sheet against Surgery; it is that, also, with which we have now to deal.

In a previous lecture I have dwelt with care and clearness on the effects of increment of animal heat. I have shown what is a fatal increment; I have shown that the direct effect of increment is to cause contraction of vessel, suppression of watery secretion, and separation of fibrine from accumulation of water in the blood.

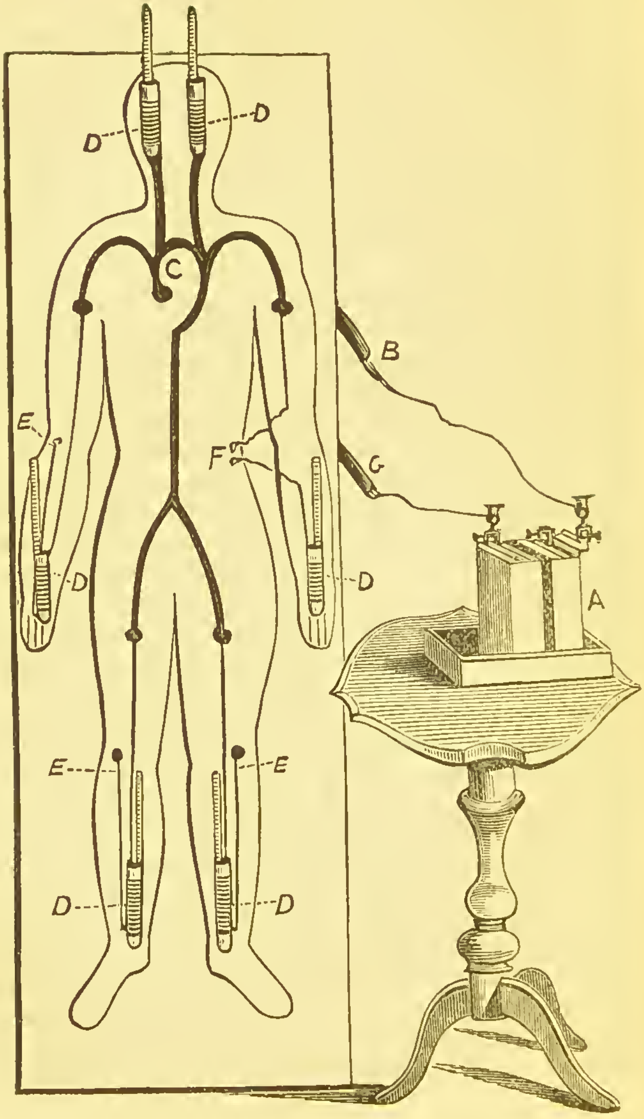
The induction of these changes within the body by increment of heat is, moreover, a simple act. An animal which cannot cool down rapidly enough to meet even a moderate increase of external temperature will show increment of heat that shall be fatal in an air in which another animal may live unaffected. An animal subjected to active oxidation while the conditions for equalisation of heat are imperfect will suffer, from increment of heat, and may die. In Surgical procedures, in Surgical operations, the production of increment of heat is equally simple. There existed in the animal before operation a given structure, through which, while that structure was in connexion with all the body, there was distributed from the combustion of so much blood a certain amount or degree of force. The Surgeon severs this structure from the rest of the body, and thereby limits, in proportion as he removes in some cases, the distribution of force derived from the main source. But observe, he but temporarily interferes with the development of force in the body as a whole, and so when the immediate depressing effect of the operation is over, when the organic mechanism swings round, to speak in common language, and rights itself, then, the active combustion restored, there will be resistance in the organism, because so much living tructure has been severed, and if there be not equalisation

from evaporation of water, or increased secretion or radiation, there will be incremeut of heat and Surgical fever.

Let me illustrate this explanation by a simple piece of mechanism which is here constructed. There arc mapped out on a board the arterial and venous systems of a man. The arteries are represented by insulated copper wires, and the veins are represented in a similar way. All the arteries have a common origin from a bundle or rope of wire which enters at what may be called the point of origin of the great aorta, C; then they divide as the great arterial trunks divide—some to the brain, some to the extremities. At the termination of each arterial course, the arterial wire is made into a fine coil representing the capillary surface, DD, DD, DD, and within each of these coils is placed a small glass tube containing a little mercury, and holding a small thermometer. The extended arterial or capillary coils terminate in the return wires, which we may call the venous wires, E, EE, and ultimately all the venous wires are made to coalesce into one cord or bundle, G, which emerges from the system at the point where the arterial cord enters. The two terminal bundles or cords are finally connected with a small Grove's battery, A; they are so connected that the voltaic current passes from the battery through the wires which represent the arterial system, through the coils which represent the peripheral system, and through the wires which represent the venous system back to the battery.

And now, when the battery is put into action, we notice this phenomenon, that the mercury in the little cups, which are surrounded by the coils, gains, as you will expect, in temperature, and, other things being equal, the rise of temperature in each cup is equal, so that the thermometer in all stands at the same level—in brief, there is equilibrium; the force derived from the battery is equally distributed to every part, and so long as the battery power remains the same, and the surrounding air the same, there is the same manifestation of heat. If the battery begins to fail, there is a general reduction of temperature; if another cell be added, there is a general gain of temperature. The changes of decrease and increase are dependent on the battery. When, then, I do not interfere with the battery, but

FIG. 1.



keep it in steady action, all the thermometers in the cups show the same degree of heat in all parts of the periphery; but if I cut off one of the limbs—say a hand from the artificial system—by dividing the connecting wire, as at F in the diagram, the temperature of the mercury in all the other cups rises, and the thermometers register the fact. The battery power is the same before as after the division, but there is so much resistance from the operation which has been performed, that there is elevation of temperature in the remaining part of the system.

If, instead of using a battery and wires, I could use tubes, like arteries, capillaries and veins, could charge them with a current of heated fluid, and could keep that fluid up to a given temperature as it circulated, I should more faithfully represent the animal mechanism, mechanically, than I have represented it here. But the facts elicited would be the same—that is to say, on cutting off a given portion of the circulating force there would be resistance in the remaining parts aud increment of heat.

The inflammatory fever of John Hunter—or sympathetic fever, as he sometimes called it—is, when simply understood, in the same manner an increment of heat from resistance, and the increase of water in the blood, the apparent increase of fibrine and the adhesive infiltrations that may follow are but the sequelæ of the first divergence from that natural process of animal motion in which there is perfected equalisation of the force produced within the organism.

You will remember an experiment performed in my lecture last year on decrement of animal heat, and I refer to it now because it illustrates well the point before us. A pigeon was put instantaneously to sleep in vapour of bichloride of methylene, and was let to die instantly. The natural temperature of the bird was 107° Fahr. before death; but so soon as the death took place, so soon as the muscular motion—motion of respiration, circulation, and digestion—ceased in the animal, the temperature rose three degrees. Why? Because in the animal after death there was still chemical action progressing for a short time, and, as that was not disposed of as motion—that is to say, as the normal process of equalisation was interfered

with—the result of the chemical changes was illustrated in elevation of temperature; the temperature of the dead animal rose until, by loss from radiation and conduction, the further rise was checked. Afterwards, as the chemical changes were not renewed, there was decline of temperature to that of the surrounding air.

There is a method by which you can make a similar observation in the simplest manner, and without devising any special or elaborate experiment. Rabbits when killed for food are usually slain by a blow on the back of the head—a very painless and humane mode of killing. When, then, this process is carried out in a warm air, the temperature of the air being from 85° to 90° Fahr., the temperature of the body will be found to rise, immediately after the fatal blow, two and a half and even three degrees, and will be sustained until there is equalisation by radiation or conduction of heat from the body. The suddenness of the arrest of respiratory, cardiac, and intestinal motion is again the cause of increase of temperature.

If, in a living animal, I could remove as much active substance as would represent the active matter of the heart, respiratory organs, and digestive organs, without touching those parts, I should have the same rise of temperature as if the motions of those organs were suddenly suspended, with this difference—that, if force should continue to be fully evolved in the living animal, the increment of heat would continue, and, with increase of resistance, would persist to increase unless it were equalised.

But let me put still a better case forward in illustration. A few weeks since Mr. Wells performed ovariotomy in a woman whose temperature before the operation was 98° Fahr. After the return to full power from the operation the temperature began to run up rapidly till it reached, such was the resistance, 104° Fahr. Suddenly there was death—death so rapid that the process for the production of heat continued, even after the respiration had ceased, and the result was that a few minutes after death the temperature of the body rose to 109° Fahr.

What instruction a case such as this affords!—what insight! The rise of animal temperature after the operation, the rise after death, both from one and the same physical cause.

The nature of the operation in respect to the part operated upon is of moment in relation to increment of heat. Some structures are interfered with with much more danger than other parts, and three structures I notice specially in this regard—the brain, the peritoneum, and, in the male, the testes.

Let us, then, keep this point fairly before us—that there will be increment of heat from resistance, Surgical fever, whenever an operation performed on the living body shall cause sufficient destruction of part to interfere with the distribution of heat, provided always that there be no compensating process set on foot to meet the difficulty.

Happily there are certain modes of compensation which, in the majority of operations, do meet the difficulty and the inevitable danger of death. In the first place, there is direct radiation of heat from the body; then there is evaporation of water as vapour; next there is the quickened movement of pulse and of respiratory muscle, which we call a symptom of fever, but which, in truth *is in the end a process of cooling;* and, lastly, there is arrest of appetite for food, and the almost complete voluntary abstinence from food. These are the equalising processes. Carried to their ultimate perfection, they restore equilibrium, and there is recovery.

Unhappily there is one process of cooling down from fever heat, in acute inflammation, which is in itself fatal—that is, a process of cooling from arrest of the current of the blood on the right side of the heart. I have described this sudden decline of temperature many times, but I cannot notice it too often; I have diagnosed from it many times with a certainty that has seemed singular, but it is a so certain and simple a diagnosis, that, when it is known, he who runs may read it.

The safe processes by which the increment of animal heat is lowered, prevail, fortunately, in the majority of cases. In this country I should judge that, in from eighty-five to ninety per cent. of Surgical operations, there is reduction of fever from compensation, with recovery, and, as there is no country where Surgical art is so bold and so skilled as it is in this, it will be quite fair to consider that our results are a just average, at

least, of the results of the world altogether. There remain, consequently, from ten to fifteen per cent. of cases in which death follows operation, and, although this is a very small number compared with the whole number operated upon, it is a huge totality per year. The cause of this mortality is a question we have to ask. We may throw overboard at once any fault in Surgical art, for although Surgeons are mortal, it is one of the wonders of the age how rarely they have an accident that is fatal in the course of an operation.

And so there remain behind those causes which were enumerated at the beginning of this lecture, chief of all Surgical fever. And now I come to this consideration :—Is the increment of animal heat influenced by external conditions, and if so, what are they? If it be so, and we can read those conditions, we can reduce mortality. We appeal first for knowledge respecting external influences. They are season, temperature, barometrical pressure, moisture of air, electrical condition of air, direction and force of wind. We will consider these briefly in detail.

Season.

When we study the influence of season in relation to changes in the body, we include in one view not only the combined influence of atmospherical changes, but certain great and singular changes which are progressing within the body itself. The general influence of season on the results of Surgical practice is of the most significant import, for Surgical fever, in relation to mortality, comports itself with all that class of general disease which is attended with increment of heat— scarlet fever, acute rheumatism, erysipelas, puerperal fever, carbuncle; and the facts relating to the mortality of all of these are in such accord they admit of no doubt. These diseases, when considered on an efficient scale, all have seasons when their mortality prevails; for example, from an analysis of 139,318 deaths from all diseases, during the year 1838 to 1853, I found by the Registrar-General's tables that the mortality from three of the diseases of the class named held the following proportion, in regard to mortality :—

	First Quarter. Jan., Feb., March.	Second Quarter. April, May, June.	Third Quarter. July, Aug., Sept.	Fourth Quarter. Oct., Nov., Dec.
Scarlet fever	20·809	18·978	26·234	33·976
Erysipelas .	25·144	23·444	22·337	29·174
Carbuncle .	29·771	19·685	24·409	29·133

Thus we see that in respect to these diseases, the congeners with Surgical fever, the mortality reached its highest in the years named at the period of the fourth quarter.

In further illustration of the same truth, let us turn to the Registrar-General's summary for the year 1868, and from this we glean the following table :—

	First Quarter.	Second Quarter.	Third Quarter.	Fourth Quarter.
Erysipelas . .	81	69	102	175
Puerperal fever	54	45	42	78
Carbuncle . .	12	8	15	16
Rheumatism .	79	93	118	184
Scarlet fever .	368	352	738	1463

It is unfortunate for us that we cannot produce elaborate tables of facts relative to Surgical operations and their results at different seasons. But I have one series of facts which is entirely to the point, and which is peculiarly valuable because it admits of comparison with the general death rate from diseases allied to Surgical fever which has been recorded above, and because one great operation is concerned and one operator. In the year 1868 Mr. Spencer Wells performed the operation of ovariotomy fifty-four times. In January, February, and March, he performed the operation sixteen times, with a result of three deaths within the fifth day after the operation. In the months of April, May, and June, he performed the operation thirteen times, with a result of two deaths, one of which was within two hours, and therefore would not reckon in our research, and one death in eighty hours. In July and August he performed the operation five times, with one death on the third day. In October, November, and December, he performed the operation twenty times, with a result of *eleven*

deaths all within the sixth day after the operation. Now, add these facts to the table for 1868 which I have quoted, and see how interesting is the lesson; how the results of the special operation tally in the main with those of the table. In the first quarter the deaths, in Mr. Wells's cases, are 1 in 5·3; in the second, excluding the death two hours after operation, 1 in 13; in the third, 1 in 5; in the fourth, 1 in 1·8.

These observations are precise, but I have observed year after year practically the same relationships. I have extended the observation to deaths in which the fatal result has been recognised as due to fibrinous deposition in the heart, of which I see so many cases; and the estimate I have been able to form from the whole series of observations has rendered me the approximate truth which is now attempted to be explained.

From the facts, then, we gather that the last quarter of the year is the period most favourable to the fatality of cases in which increment of animal heat is the first and distinguishing symptom. The last quarter is clearly the central quarter of the season in which these diseases are most fatal. There are fluctuations sometimes on the side of the quarter which precedes it, and sometimes on the side of the quarter which follows it, but it retains its plaoe.

Singularly, too, the December of this quarter is the centre of a period of seven months—September, October, November, December, January, February, and March—during which there is occurring in the animal organism a marked modification in the nutrition as compared with the five remaining months —April, May, June, July, and August. In the period in which December is the centre, there is, as the admirable researches of the late Mr. Milner, of Wakefield, have shown, a determinate loss of animal weight in persons living under the same precise circumstances in respect to food, clothing, and exercise; while in the five other months there is an increase of weight. The maximum of decrease is in March, of increase in August.*

* Mr. Milner's observations on this subject are in their way the most laborious and valuable on record. From his position as Surgeon to the convict establishment at Wakefield, Mr. Milner was enabled to weigh every prisoner at given periods, to compare the gain and loss throughout the

Special Meteorological Influences.

So far we have considered the general influences of the seasons on Surgical mortality, but to rest on this consideration would lead us into error. The seasons afford great outlines for study, but nothing more, and we should soon be plunged

year, and to estimate such gain and such loss, by individual against individual, and by diet against weight. The prisoners upon whom the observations were made had been sent to Wakefield to undergo the first portion of their punishment. They were kept in separate cells for a period of nine months, they were all males between the ages of 15 and 60, and they were all in good health when they arrived. Their cells having an equal capacity and the same means of ventilation, they were served with the same quantity and character of air, and the mean temperature of the cells was in every case 61°. The men were all fed on the same kinds of food, they were all dressed in the same attire, and they were made to take the same amount of exercise. They were weighed on admission, and again at the latter end of every calendar month during their stay. The number of men weighed by Mr. Milner exceeded 4000; the period of time occupied in his observations was ten years; the average number of prisoners weighed monthly was 372; and the total number of individual weighings was 44,004. To begin with the first months of the year, he found that the body undergoes an average loss of weight in January, February, and March, the proportion of loss being 1·14 in January, 0·24 in February, and 0·95 in March. During the months of April, May, June, July, and August, there is gain in the following proportions:—For April, 0·03; for May, 0·01; for June, 0·52; for July, 0·08; or August, 0·70. In September, October, and December, there is loss in proportion of 0·21 for September, 0·10 for October, and 0·03 for December. November presents an exception to the months that precede and follow it, there being an average gain of 0·004; so that, at first sight, November would seem to be an exception in the losing series of months that precede and follow it, in a very, very slight degree. But Mr. Milner points out that this apparent exception was caused in the prisoners by the arrival of large numbers of new men in each year, and from the fact that the men usually gain weight for a short time after they are received; so that this break in the series results from the influence of the stage of imprisonment. On the whole, there is an average loss beginning in December, and increasing rapidly up to March. In April there is an abrupt gain, which extends irregularly until August. In September there is a rapid loss, which continues, but not to the same extent, through October. From these facts Mr. Milner draws the following inferences:—1. The body becomes heavier during the summer months, and the gain varies in an increasing ratio; 2. The body becomes lighter during the winter months, and the loss varies in an increasing ratio; 3. The changes from gain to loss, and the reverse, are abrupt, and take place about the end of March and the beginning of September.

into a sea of troubles if we were to think of them only. We may have, in fact, different results in different seasons, because there may be and are differences in the same seasons which will rule and govern results. We are bound, therefore, to enter into details, and are forced to inquire what is there in some seasons that should lead to important differences in the mortality from those forms of disease which are marked by fever or increment of animal heat. My idea is that, on purely physiological grounds, we have reason of the simplest physical kind for that increase of temperature, sometimes fatal, which succeeds the performance of a Surgical operation of a severe character. I think the fever is due to resistance of motion. We have seen that whenever the animal temperature is raised there is danger, unless there be established a compensation by radiation, and specially by evaporation of water from the body. Now, when we come to consider the influences of atmospherical condition in relation to mortality, we find a series of direct agencies leading to interference with the process of evaporation when the mortality is high. Let us, in example of this fact, take the external conditions of the year 1868 at the height of 160 feet above the level of the sea.

Year 1868.

	Barometer.	Humidity of air.	Weight of cubic foot of air.	Temperature, mean.
First quarter .	29·845	82	552·3	41·4° Fahr.
Second quarter .	29·869	73·3	536	55·8° Fahr.
Third quarter .	29·773	70	526	63·9° Fahr.
Fourth quarter .	29·669	88·3	544·3	45·1° Fahr.

From this table let the eye be carried back to the tables and facts of mortality which have already been given, and the mind will then appreciate the special meteorological characteristics which run with the lower and the higher mortalities.

In a physiological point of view we see in these conditions of air all that is necessary to account for the attendant results. Low barometrical pressure, excess of humidity of air, and a temperature low, but not low enough to compensate for increase of heat by arrest of oxidation or by abstraction of heat. These

are the precise conditions by which in experiment we should expect to produce an elevation of animal temperature with or even without injury. They are conditions the most unfavourable to equalisation of heat by evaporation and radiation. And thus I am brought to advance the general rules—not as absolute rules, but as approximations to the truth—that, with a barometrical reading below 29·670, humidity above 80, and a mean temperature below 50° Fahr., the conditions are unfavourable for recovery from large Surgical operations. On the other hand, the conditions are favourable with the barometer at or over 29·869, the degree of humidity about 73, and the mean temperature not less than 55° Fahr.

To enable the Surgeon to act on the rules thus submitted, I have requested Messrs. Horne and Thornthwaite to construct for me the small portable apparatus which is now before you. It consists of a little cabinet perforated on each side for the free admission and circulation of air, and provided with a dry and wet bulb thermometer and an aneroid barometer. This cabinet can be carried conveniently to the place where a Surgical operation is to be performed, and can be put in the ward or chamber where the patient lies. To make it more useful, I have added to it a few simple rules for the guidance of the Practitioner.

You will observe that I have as yet said nothing respecting the presence or absence of ozone or the detection of it. There is not much to be said. At the present time the modes of determining ozone and the tests for ozone, in the external air, are very unsatisfactory. Ozone is so readily used up, in crowded communities, by organic decomposing matters in the air, that it may really be present and yet not be detectible by the common tests now in use. In a conjoint paper by Dr. Moffatt and myself, contributed to the Epidemiological Society in March, 1854, we showed that with certain of the winds there are periods of ozone, and that with other winds there may be no ozone, the ozone periods accompanying south or equatorial currents of wind, and the periods of absence of ozone being those when the north or polar currents of wind prevail. The periods of ozone correspond with those seasons when there is increase of

febrile disease, and an argument might be raised that excess of ozone in the air would favour increase of animal heat.

Fig. 2.

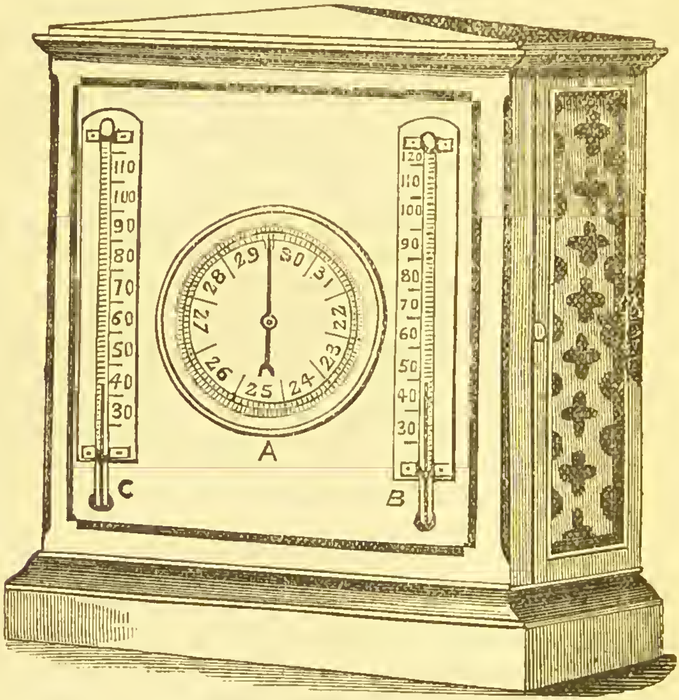


Fig. 2.—a, barometer; b, dry-bulb thermometer; c, wet-bulb thermometer.

Indeed, I can induce increase of temperature in an animal by submitting it to ozone at a temperature above 70°. But I would not press this point further, because of the uncertainty of tests for ozone. The fact nevertheless of the concurrence of ozone periods with seasons which are favourable to fever, or increment of animal heat, ought to be remembered.

The direction of the wind is connected, in observation, with

the barometrical readings and humidity. South and south-westerly winds are, I think, unfavourable to operation; westerly and north-westerly are favourable; north and north-easterly, and even easterly, winds are not unfavourable. As to the *force* of the horizontal movement of the wind, I have not been able to determine as yet that it makes any material difference in relation to mortality.

On the whole, I believe that the readings of the barometer and of the dry and wet bulb thermometers are the most practical and useful guides in respect to Surgical operations, and the hours favourable or unfavourable for the performance of operations.

Artificial Remedial Measures.

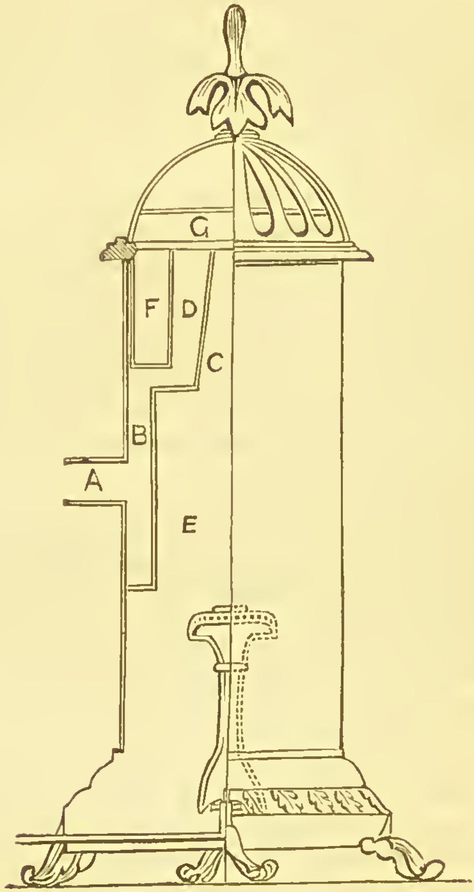
One other subject remains to be considered; I mean the artificial means which are at our command to meet atmospheric changes. We have at command the means for meeting two atmospheric conditions; we can regulate temperature, and we can determine humidity. These are always important considerations, and at all seasons, even the best, should have the fullest attention. With the little cabinet of instruments now before us, a nurse can read temperature, humidity, and barometrical pressure, with ease, in the sick room.

But to regulate temperature and humidity, a proper and scientific administration of air into the room or ward is required. Our present systems are a universal mistake. The open firegrate and open window are practically worthless proceedings; indeed, the open window is an absolute danger. We have, however, now at our service one or two methods by which we can regulate the amount of air, the warmth of air. and the humidity.

In the diagrams there are represented, in section, two stoves which meet the objects in view; the stoves themselves are on the lecture table. The long stove (Fig. 3), called by its inventor the "hygrometric," is invented by Mr. Jones, of Aylesbury, and was exhibited last year at the Medical Society of London, with a description of its action by Mr. Ceeley. The stove consists of a hollow metallic cylinder, the interior of which is heated by gas or by a large lamp. Through the tube, A, air is admitted from the

outside; the space B is a chamber surrounding the inner stove, where the air is heated; through the chimney, C, products of combustion escape. The space E is the inner stove. The space F is a water-dish, over which, if required, the air from without

Fig. 3.



can pass after being warmed; (this, also, could be made a drying-dish). The space D is the space between the water-dish and

chimney, through which the warm air passes to the upper perforated vault or chamber, where it is deflected by the damper G, and then passes into the room.

The shorter stove (Fig. 4) is the invention of Mr. Webb George. It consists of a furnace, A, surrounded by a cylinder of wrought iron. At the lower part of the stove and behind, a tube enters from the outer air, which tube forms a spiral within the stove, and terminates at the upper part, B. The air is thus simply heated by passing through the spiral, and the products of combustion are carried away by the flue, which is provided with a damper, D. By making an extra chamber at C the air can be carried over a drying surface, and can be brought into the room in any degree of humidity. This stove answers exceedingly well when it is properly managed, and by it, in a small room, the air can be raised to 140° Fahr. The introduction, rapidly, of pure air secures also a good ventilation.

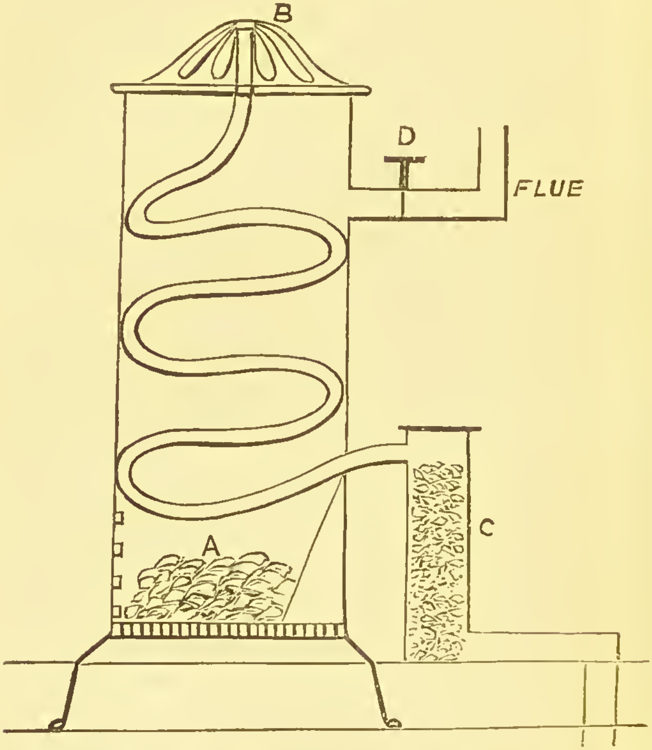
But, after all, these arrangements do not meet the difficulty of atmospheric pressure. When the barometer is low there are changes in the body which are not easily explained. There is tendency to congestion of lung and to mechanical resistance in the pulmonary circuit; there is tendency to exudation of fluid from wounded surfaces, there is a feebleness in the healing of wounds, and in the body generally a susceptibility to disturbance which is not presented when the atmospheric pressure is firm and at its maximum. We are indeed, in health, made sensible of low barometrical pressure by many signs: toothache, pains in the joints, what are commonly called nervous symptoms, these are signs, with others, with which we are most of us familiar; signs which one of our immortals, Jenner, has epitomised, in by no means contemptible verse, as an excuse for declining the invitation of a friend to make a country excursion.*

Lastly, when the barometric pressure is low, the production of secondary animal poisoning is a marked phenomenon. It is as though the fluids then secreted by wounded and diseased surfaces

* See life of Jenner, in "Lives of British Physicians," edited by our friend, John Fernandez Clarke, who seems to live—and may the life be long—with his illustrious brethren of the dead.

undergo a peculiar decomposition yielding products which by reabsorption excite, in turn, secondary fever. Mr. Wells's cases afford striking evidence of this practical fact. In some of his cases the increment of heat, the Surgical fever, is primary,

Fig. 4.



comes direct with the reaction, and causes death in forty or fifty hours; in other cases the fever is secondary, comes on many hours after the operation, and causes death on the fourth, fifth, or sixth day.

We want, then, proper means for regulating *all* atmospheric conditions in the sick ward. Meanwhile, the Surgeon, when he is not pressed for time, may constantly take advantage of

simple natural conditions favourable to his operative work. What these natural conditions are may be stated under a few separate heads.

General Rules for reading Meteorological Conditions, as a Guide to Major Surgical Operations.

The time is favourable for operation—

(*a*) When the barometer is steadily rising.

(*b*) When the barometer is steadily high.

(*c*) When the wet-bulb thermometer shows a reading of five degrees lower than the dry-bulb.

(*d*) When, with a high barometer and a difference of five degrees in the two thermometers, there is a mean temperature at or above 55° Fahr.

The time is unfavourable for operation—

(*a*) When the barometer is steadily falling.

(*b*) When the barometer is steadily low.

(*c*) When the wet-bulb thermometer approaches the dry-bulb within two or three degrees.

(*d*) When, with a low barometrical pressure and approach to unity of reading of the two thermometers, there is a mean temperature above 45° and under 55° Fahr.*

I have said before, and readily repeat, that these rules are approximative only; but I venture to affirm that if in our large Hospitals careful observations were carried out bearing on the question of mortality in relation to meteorological conditions, the rules would be proved as substantially correct. I believe, further, that if the results of operations performed in those places where the air is dry, the temperature uniformly high, and the mean barometrical pressure high, were compared with results obtained in other places where the opposite general conditions obtain, the correctness of the rules would also, in the main, be substantiated.

* For particulars as to method of reading the instruments in the Medical meteorological cabinet, I would direct the reader to Mr. Glaisher's admirable little work entitled "Hygrometrical Tables," published by Taylor and Francis, of Red Lion-court, London. I would also return my thanks to Mr. Glaisher for having most kindly read for me the "revise" of this lecture.

A word in conclusion respecting the mortality of operations in patients of different ages. We know as a general truth that the mortality after great operations is lower in the young than in the advanced in life. In one operation—lithotomy—we have fairly discovered the rate of difference. The reason of the difference seems to me intelligible enough. In the young the tissues of organs are elastic, the organs are more faithfully acting in accord, the excretory power is free, the muscles on which the organic life depends are vigorous, and the body generally is not embarrassed with non-conducting fatty substance. In those who are advanced in life the conditions are not the same; the tissues are firm, some organs are failing in power, secretion is less active, the heart and respiratory muscles are feebler. In the young, consequently, there is capacity for compensation; in the thoroughly formed body there is less capacity for compensation to meet *resistance.*

APPENDIX.

SINCE the publication of my last lecture "On Meteorological Readings in Relation to Surgical Practice," I have become indebted to Dr. Silver for a knowledge of au essay on the same subject published by Dr. Addinell Hewson in the *Pennsylvanian Hospital Reports*, vol. ii. 1869. I was not until now aware that in any Hospital in the world a register of Surgical operations had been kept, together with a meteorological register. But from Dr. Hewson's admirable contribution I learn that, for the long period of thirty years, records of the cases of primary amputation previous to the year 1860 have been stored up at the Pennsylvanian Hospital, with a meteorological register, "most faithfully kept at the Hospital during all that period by Dr. Conrad, the Apothecary." I learn, further, that the total number of cases of operation for which the Pennsylvanian Surgeons have full meteorological records is 259; the results as analysed by Dr. Hewson stand as follows:—

"On the occasion of the 259 operations, the barometer was ascending in 102, descending in 123, and stationary in 34.

"Fifty-four of the whole number were fatal; 11 of them were operated on when the barometer was ascending, 35 when it was descending, and 8 when it was stationary.

"Of the successful cases, 91 were operated on with an ascending barometer, 88 with it descending, and 26 with it stationary.

"From which it would seem," says Dr. Hewson, "that we got a mortality, when the operation was performed with the barometer ascending, of not quite 11 (10·7) per cent.; of over 20 (20·6) per cent. with it stationary; and over 28 (28·4) per cent. with it descending."

"Of the fatal cases, the average length of time which the patient survived the operation was only seven days when the barometer was ascending, and thirteen when it was descending; and of the cases which died within three days over 75 per cent. were when the barometer was ascending."

In so far, then, as general results are concerned, Dr. Hewson is brought by his precise statistical evidence to the same point as myself. Thinking by different methods, we have converged to the same truth. He had the advantage of comparing thirty years' direct Surgical observation side by side with thirty years' meteorological observation. I was obliged to consider Surgical fever in conjunction with its allies, and to compare these to-

gether by the side of the meteorological conditions; but I had what to me was an advantage, the teaching of experiment, directing me steadily towards the light.

In one direction Dr. Hewson has arrived at a new inference which I could not arrive at from the materials at my command. He connects, as I have done, fatal pyæmia with low barometrical pressure and moisture of air. On the other hand he connects death from Surgical "shock" with the opposite atmospherical conditions; but, as deaths from shock are comparatively rare, we are at one as to the soundness of the rule of performing operations when the barometer is rising. I seize, with unusual pleasure, the earliest opportunity of recognising the labours of Dr. Hewson and those others of our Pennsylvanian brethren upon whose researches his deductions are based. I had feared that the views I ventured to set forth in my lecture would have to wait long before they received corroboration. To find that they have been independently advanced and supported in another country, and on a plan of observation so unprecedented, is, therefore, a gratification as great as it was unexpected.

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